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MOTOR CONTROLLER.

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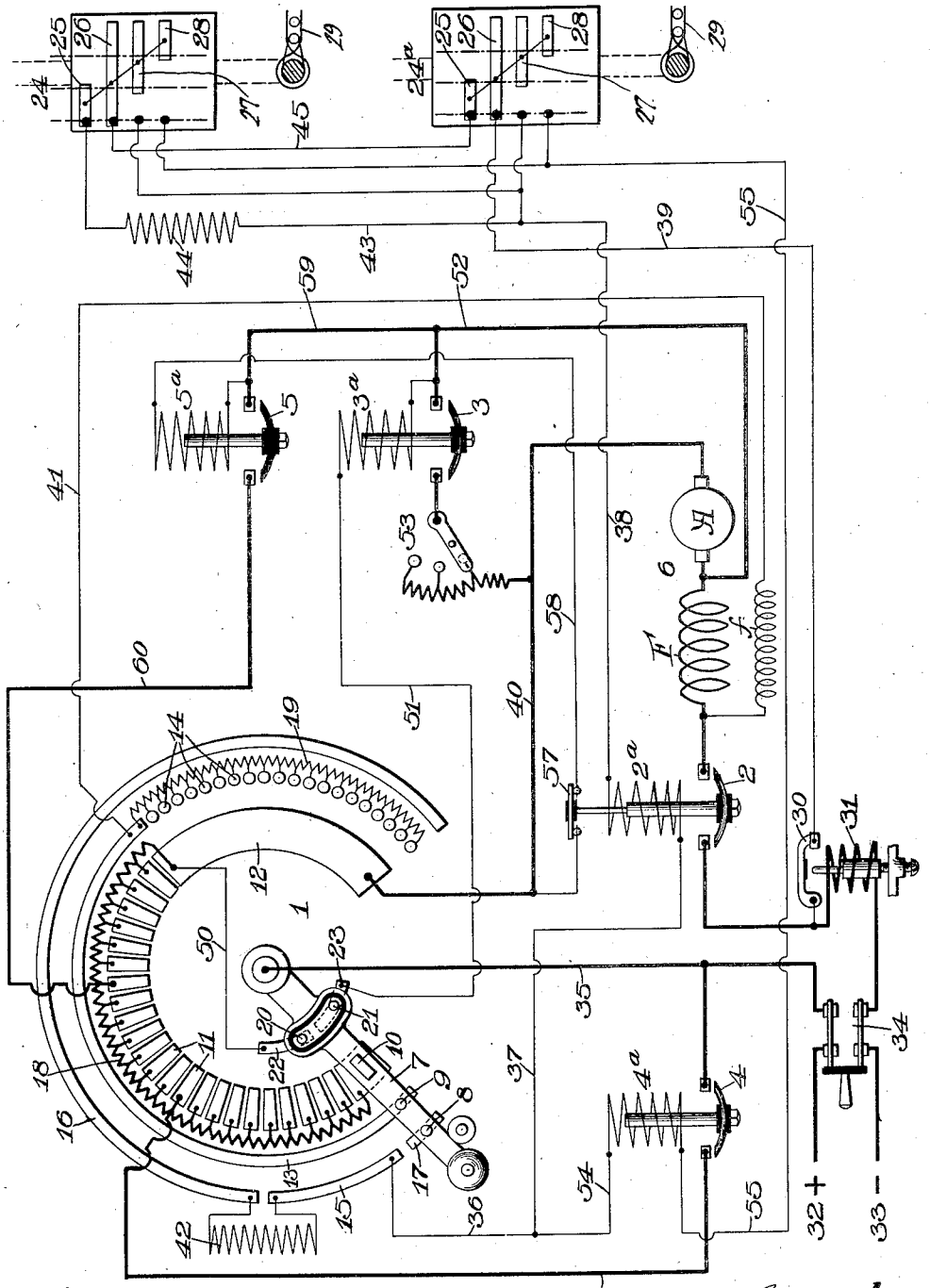

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MOTOR-CONTROLLER.

1,016,470. Specification of Letters Patent. Patented Feb. 6, 1912.

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To all whom it may concern:

Be it known that I, THOMAS E. BARNUM, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Motor-Controllers, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in controllers for electric motors and more particularly to controllers for operating one or more motors either at slow speed or at normal high speed. Such controllers are particularly adapted for use in connection with motor-operated printing presses and various other kinds of motor-operated machinery, where it is desired to operate the driven mechanism at slow speed and then stop the same in predetermined positions for inspection, adjustment, repairs, etc. Such an operation of a printing press is commonly known as teasing, inching or jogging the press.

One object of my invention is to provide means whereby the motor may be operated at different predetermined slow speeds.

A further object of my invention is to provide auxiliary means for starting the motor for teasing or inching when the friction of rest of the driven mechanism is so great that the motor will not start under the control of the usual teasing or inching means.

A still further object of my invention is to provide one or more switches arranged at suitable points around the driven mechanism, any one of which may be operated to control both the usual teasing means and the auxiliary teasing means.

Various other objects and advantages of my invention will be hereinafter clearly and fully set forth.

For the purpose of more fully disclosing the nature of my invention, I shall describe the system of control diagrammatically illustrated in the accompanying drawing which embodies my invention in one form. It should be understood, however, that my invention is not limited to the particular system of control illustrated in the drawing, but is capable of various modifications.

The system of control illustrated includes a manually operated controller 1, a main switch 2, an auxiliary speed controlling switch 3, an auxiliary teasing switch 4, and a dynamic braking switch 5.

As will be hereinafter set forth, the main switch 2 is arranged to complete the circuit of the motor 6. The motor which I have shown for the purpose of illustration is of the compound type, being provided with an armature A, a series field winding F and a shunt field winding *f*. It should be understood, however, that my invention is applicable to other than compound motors. The speed of the motor is controlled by the controller 1 which I shall now describe.

This controller comprises a movable element 7 which carries three contact brushes 8, 9 and 10. As the member 7 is moved to the right from the position shown in the drawings, the brush 10 first sweeps over a series of contacts 11 and then over a contact segment 12. The brush 9 first engages a contact segment 13, and then sweeps over a series of contacts 14. The brush 8 is adapted to engage contact segment 15, and, upon leaving this segment, to engage a segment 16. In initial position of the member 7, the brush 8 engages a dead contact 17. The series of contacts 11 are connected to an armature resistance 18, while the series of contacts 14 are connected to a field regulating resistance 19. In addition to the brushes mentioned, the member 7 carries two electrically connected brushes 20 and 21, arranged to engage contact segments 22 and 23 respectively, while the member 7 is within a predetermined distance from its initial position. While the brushes 20 and 21 are electrically connected, they are both insulated from the member 7 and are provided merely to electrically connect the contact segments 22 and 23 when the member 7 is in certain positions for the purpose hereinafter set forth.

The switches 2, 3, 4 and 5 are provided with operating windings 2^a, 3^a, 4^a and 5^a respectively. For controlling the circuits of the operating windings of the switches 2 and 4, I provide suitable master switches 24 which may be of any preferred type and of any desired number. As illustrated, the switches 24 are provided with contact segments 25, 26, 27 and 28, each adapted to engage a stationary contact finger. In prac-

tice, I prefer to provide the switches 24 with suitable centering springs 29 for normally holding the same in the position illustrated; that is, in such a position that the segments 25 and 26 normally engage their respective contact fingers, it, of course, being understood that the switches may be moved so as to disengage the segments 25 and 26 from their stationary contacts. In practice, I also preferably provide an overload switch 30, having an operating winding 31. The function of this switch will be hereinafter set forth.

The circuit connections of the system will be clearly set forth in the following description of the operation of the controller.

Assuming the several switches to be in the position illustrated in the drawing, no current would flow through the system from the main lines 32 and 33. In order to start the motor either for teasing or for running, it is first necessary to move the controller arm 7 so that the brush 8 carried thereby will leave the dead contact 17 and engage the contact segment 15. When the member 7 has been moved into such a position, any one of the switches 24 may be operated to cause the energization of the operating winding of the main switch. For the purpose of distinction, I shall designate the lower master switch as 24^a. If it be desired to start the motor by the use of the master switch 24^a, it is necessary to move the same so that the segment 27 thereof will engage its stationary contact. This completes a circuit from main line 32 through one side of the double pole switch 34, by conductor 35 to member 7 of the controller 1, thence through said member by brush 8 to segment 15, by conductors 36 and 37, through the winding 2^a of the main switch 2, by conductor 38 to segment 27 of switch 24^a to segment 26 thereof, and by conductor 39 through the overload switch 30 to the opposite side of the main line. This causes the energization of the winding 2^a which thereupon closes the switch 2. Closure of the switch 2 completes the motor circuit from the movable member of the controller 1 by brush 10 to one of the contacts 11, thence through the armature resistance 18 to segment 12, by conductor 40 through the motor armature A and series field winding F, and through main switch 2 to the opposite side of the main line. At the same time, circuit is also closed from brush 9 of the rheostat member 7 by contact segment 13 to conductor 41 through the shunt field winding *f* of the motor. The motor is thus started with all of the armature resistance in circuit. To increase the speed of the motor, the controlling member 7 should be moved to the right to gradually remove the armature resistance from circuit. To still further increase the speed of the motor, after all of the armature resistance has been removed from circuit, movement of the controlling member 7 may be continued so that the brush 9 thereof will pass over the contacts 14, thereby inserting the resistance 19 in the shunt field circuit of the motor. When the motor has attained the desired speed, the member 7 may be stopped and left without further attention.

Upon the brush 8 of the member 7 leaving the segment 15, and passing onto the segment 16, a resistance 42 is inserted in circuit with the winding of the main switch 2^a. The insertion of this resistance prevents the reclosure of the main switch 2, should it open, until the movable member 7 of the controller is moved back onto the contact segment 15, thereby short-circuiting the resistance 42. The purpose of this arrangement is to prevent starting of the motor until the member 7 has been returned to its initial position to remove all of the resistance from the shunt field circuit of the motor and to insert a predetermined amount of the resistance 18 in the armature circuit.

Immediately upon closure of the main switch, the master switch 24^a, or 24, whichever was operated, may be released, thereby causing the segment 27 to disengage its stationary contact. This would interrupt the circuit of the winding 2^a, but for the fact that a maintaining circuit is established therefor from conductor 38 by conductor 43, through a resistance 44 to segment 25 of the master switch 24, thence to segment 26 thereof, by conductor 45, to segment 25 of the master switch 24^a, to segment 26 thereof, and thence to the negative side of the line as already traced. The resistance 44 is provided, in this maintaining circuit, to prevent closure of the switch 2 by merely moving the member 7 into engagement with the segment 15. This arrangement necessitates closure of the motor circuit by means of one of the master switches, and thus renders it impossible for the attendant to start and stop the motor by means of the controller 1 as they would be likely to do if no such provision was made. Such an operation of the member 7 would be injurious to the controller 1.

Having thus described how the motor may be started and brought up to normal speed, I shall now describe the teasing operation.

In order to tease or inch the driven mechanism, it is first necessary to close the main switch 2. As has previously been set forth, in order to close the circuit of the operating winding of this switch, it is first necessary to move the controlling member 7 into engagement with the contact segment 15. The main switch 2 may then be closed in the manner previously set forth by operating either one of the switches 24 or 24^a. The speed at which a motor may be inched or

jogged is necessarily low, owing to the insertion of practically all of the resistance 18 in the armature circuit thereof. However, the slow speed may be varied within predetermined limits by adjusting the element 7 to remove the first few steps of the armature resistance. It will be noticed, however, that for teasing purposes the controller arm 7 must be left in engagement with the segment 15 inasmuch as upon leaving this segment, it either opens the circuit of the operating winding of the main switch, or inserts the resistance 42 therein. As previously set forth, the insertion of the resistance 42 prevents reclosure of the main switch 2 after it has once been opened, and thus the motor could not be teased if the controlling member 7 was moved into engagement with contact segment 16.

If it is desired to tease the motor at a still lower speed than is provided by the controller 1, the member 7 should be left in such a position that the brushes 20 and 21, carried thereby, will electrically connect the segments 22 and 23. The bridging of the segments 22 and 23 connects the operating winding 3^a of the switch 3 across the terminals of the motor armature A. This circuit may be traced from one terminal of the motor armature by conductor 40 to contact segment 12, by conductor 50 through the segments 22 and 23 by conductor 51, through the winding 3^a, by conductor 52 to the opposite terminal thereof. Hence, when the motor starts, it generates a gradually increasing C. E. M. F. When the motor attains a predetermined slow speed, the C. E. M. F. generated thereby, is sufficient to cause the winding 3^a to respond to close the switch 3. Closure of the switch 3 completes a circuit in parallel to the motor armature, which circuit may be traced from conductor 40 through a variable resistance 53, through switch 3, by conductor 52 to the series field winding F. The establishment of this parallel circuit reduces the flow of current through the motor armature in a well known manner, and, consequently, decreases the speed thereof. The maximum speed at which a motor may thus operate with the controlling member 7 in the position described may be regulated by inserting more or less of the variable resistance 53 in the shunt circuit around the motor armature. While the controlling arm 7 engages contact segment 15, the motor may be started and stopped any number of times by merely operating any one of the master switches.

It frequently occurs that the friction of rest of the driven mechanism is so great that the motor will not start upon closure of the main switch 2, and, for starting the motor under such conditions, I have provided the switch 4. The circuit of the operating winding of this switch may be closed at any time while the controlling member 7 engages the contact segment 15 by moving either of the master switches into such a position that the segment 28 thereof will engage its stationary contact. This connects the operating winding 4^a in parallel to the winding of the main switch. This circuit may be traced from conductor 36, by conductor 54, through the winding 4^a, by conductor 55 to the switch contact 28 of either master switch, thence to contact 26 thereof, and thence back to the negative side of the main line as already traced in connection with the winding 2^a. Upon closure of the switch 4, the motor circuit extends from main line 32 through the switch 4, by conductor 56, through only a portion of the resistance 18 and through the motor already traced. It will thus be seen that closure of the switch 4 short-circuits a considerable portion of the resistance 18, and, consequently, provides for a greater starting current for the motor than can be obtained through the manipulation of the controlling arm 7. Ordinarily, as soon as the motor has started, even though the friction of rest is great, it will operate thereafter with a less supply of current. Thus, when the motor has been started, the master switch may be released, thereby deënergizing the switch 4, but maintaining the switch 2 in closed position as already set forth.

When the motor circuit has been closed for jogging or teasing, or, in fact, whenever the motor is in operation, it may be stopped by manipulating any one of the master switches. To stop a motor, one of the master switches should be moved so as to disengage the segments 25 and 26 from their respective contacts, thereby opening the maintaining circuit of the winding 2^a.

The main switch 2^a is arranged to operate an auxiliary switch 57, which is adapted to be closed when the main switch 2 is opened. Closure of the switch 57 completes a circuit from one terminal of the motor armature by conductor 40, through switch 57, by conductor 58, through the winding 5^a of the dynamic braking switch 5, by conductors 59 and 52 to the opposite side of the motor armature. Hence, if the motor continues to operate under the impetus of its load after the switch 2 is opened, it will act as a generator and send a current through the circuit of the winding 5^a. This causes the closure of the switch 5 which then completes a dynamic braking circuit across the terminals of the motor. This circuit may be traced from one terminal of the motor armature by conductors 52 and 59, through switch 5, by conductor 60, through a portion of the resistance 18, by contact segment 12, to conductor 40 and thence to the opposite terminal of the motor armature. The establish-

ment of this circuit quickly brings the motor to rest. When the motor is brought to rest, the winding 5^a becomes deënergized, thereby causing the switch 5 to open.

The purpose of the overload switch 31 is to open the circuit of the operating winding of the main switch 2 upon an excessive flow of current through the motor, thereby causing the opening of said main switch. The motor cannot be again started until a sufficient amount of protecting resistance is inserted in circuit therewith.

What I claim is:

1. In a controller for electric motors in combination, a plurality of devices for starting the motor under different potential conditions, and common controlling means for said devices.

2. In a controller for electric motors, in combination, a plurality of devices for starting the motor under different potential conditions, and one or more controlling devices, each adapted to control the operation of all of said starting devices.

3. In a controller for operating an electric motor at a relatively slow speed in combination, a resistance, a switch for closing the motor circuit with said resistance included therein and a second switch adapted to be operated to remove a portion of said resistance to start the motor upon failure of said first mentioned switch to start the motor, said second mentioned switch being automatically caused to reinsert said portion of said resistance.

4. In a controller for operating an electric motor at a relatively slow speed in combination, a switch for closing the motor circuit, a variable resistance, a controlling element adapted to be set to include a predetermined amount of said resistance in the motor circuit upon closure of said first mentioned switch, and a second switch adapted to be operated to temporarily remove a portion of said resistance to start the motor upon failure of said first mentioned switch to start the motor.

5. In a controller for operating an electric motor at a relatively slow speed in combination, a resistance, a switch for closing the motor circuit with said resistance included therein, a second switch for removing a portion of said resistance to start the motor upon failure of said first mentioned switch to start the motor, and a controlling device for causing operation of one or both of said switches at will, said controlling device tending to cause said second mentioned switch to reinsert said portion of said resistance.

6. In a controller for electric motors, in combination, a resistance, a controlling element therefor included in the motor circuit, an electromagnetically operated switch for controlling the motor circuit, means necessitating the movement of said element to include at least a predetermined amount of said resistance in the motor circuit prior to the operation of said switch, and an electromagnetically operated switch adapted to be actuated to remove a portion of said resistance from the motor circuit.

7. In a controller for electric motors, in combination, a resistance, a controlling element therefor included in the motor circuit, an electromagnetically operated switch for controlling the motor circuit, means necessitating movement of said element to include at least a predetermined amount of said resistance in the motor circuit prior to the operation of said switch, an electromagnetically operated switch adapted to be actuated to remove a portion of said resistance from the motor circuit, and one or more master switches each adapted to control the operation of both of said switches.

8. In a controller for electric motors, in combination, a resistance, an electroresponsive switch for closing the motor circuit with a predetermined amount of said resistance included therein, an electroresponsive switch adapted to be actuated to remove a portion of said resistance from the motor circuit, and one or more master switches, each adapted to be actuated to cause one or both of said switches to respond, said master switches, when returned to normal position, being adapted to cause said second mentioned switch to open and to maintain said first mentioned switch closed.

9. In a controller for electric motors, in combination, a resistance adapted to be included in the motor circuit, a movable controlling element therefor, an electroresponsive main switch for controlling the continuity of the motor circuit, means necessitating movement of said element to include at least a predetermined amount of resistance in the motor circuit prior to the operation of said main switch, an auxiliary electroresponsive switch adapted to be operated to remove a portion of said resistance from the motor circuit, means for controlling the operation of both of said switches, and means for automatically establishing a dynamic braking circuit for the motor upon the opening of said main switch.

10. In a controller for electric motors, in combination, a resistance adapted to be included in the motor circuit, a movable controlling element therefor, an electroresponsive main switch for controlling the continuity of the motor circuit, means necessitating movement of said element to include at least a predetermined amount of resistance in the motor circuit prior to the operation of said main switch, an auxiliary electroresponsive switch adapted to be operated to remove a portion of said resistance

from the motor circuit and one or more master switches, each adapted to cause one or both of said switches to respond.

11. In a controller for electric motors, in combination, a potential regulating device for the motor having a movable controlling element, an electroresponsive main switch for controlling the motor circuit, means necessitating movement of said element to a position within predetermined limits prior to the closure of said main switch, and an auxiliary electroresponsive switch adapted to be actuated to increase the potential impressed upon the motor, and means for controlling the operation of said auxiliary switch, said means when returned to normal position being adapted to cause said auxiliary switch to return to initial position.

12. In a controller for electric motors, in combination, a potential regulating device for the motor having a movable element, an electroresponsive main switch, means necessitating movement of said element to a position within predetermined limits prior to the closure of said main switch, an auxiliary electroresponsive switch adapted to be operated to increase the potential impressed upon the terminals of the motor, and means adapted to automatically operate when said element is in a predetermined position to maintain the speed of the motor within predetermined limits.

13. In a controller for electric motors, in combination, a potential regulating device for the motor having a movable element, an electroresponsive main switch, means necessitating movement of said element to a position within predetermined limits prior to the closure of said main switch, an auxiliary electroresponsive switch adapted to be operated to increase the potential impressed upon the terminals of the motor, an electromagnetically operated switch arranged to have its operating winding connected across the terminals of the motor armature when said element is within predetermined limits, and a resistance arranged to be connected in parallel to the motor armature by said last mentioned switch to maintain the speed of the motor within predetermined limits.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

THOMAS E. BARNUM.

Witnesses:
FRANK H. HUBBARD,
WALTER E. SARGENT.